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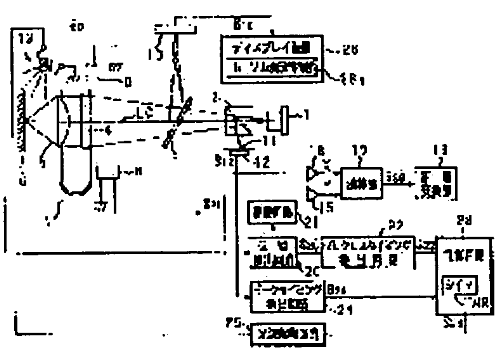
(54) DISPLACEMENT GAUGE



(57)Abstract:

PURPOSE: To provide a displacement gauge which can measure the displacement on the surface of an object and can display the inclination of the surface for measuring the displacement.

CONSTITUTION: The displacement gauge comprises a light source 1 for projecting a light on an object 6, an image pickup light source 13 for irradiating the object 6 with a light having wavelength longer than that of the light emitted from the light source 1, an objective lens 5 for passing the lights emitted from the light sources 1, 13 and reflected from the object 6, a half mirror 3 receiving the reflected lights passed through the objective lens 5, and an element 10 receiving the light reflected from the half mirror 3 thus picking up the surface image of the object.

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CLAIMS

[Claim(s)]

[Claim 1] A displacement gage which is characterized by providing the following and with which the 1st light source projects light which carried out outgoing radiation on a device under test through an objective lens, receives the reflected light from a device under test which passed along this objective lens by light sensing portion, and measures a variation rate of a front face of a device under test The 2nd light source which irradiates light of wavelength of light in which said 1st light source carries out outgoing radiation, and different wavelength to said device under test The image pick-up section which is projected on light from the 1st light source reflected by device under test, and the 2nd light source through said objective lens, and picturizes an image on a front face of a device under test by the reflected light of light from the 2nd light source A means to create a signal which may display a mark for comparing with a condensing location of light from the 1st light source on an image obtained in this image pick-up section in piles

[Claim 2] A displacement gage which is characterized by providing the following and with which the 1st light source projects light which carried out outgoing radiation on a device under test through an objective lens which vibrates with predetermined amplitude in the direction of an optical axis of this light, receives the reflected light from a device under test which passed along this objective lens by light sensing portion, and measures a variation rate of a front face of a device under test based on a location of an objective lens at the light-receiving output maximum event of this light sensing portion The 2nd light source which irradiates light of wavelength of light in which the 1st light source carries out outgoing radiation, and different wavelength to a device under test The image pick-up section which is projected on light from the 1st light source reflected by device under test, and the 2nd light source through said objective lens, and picturizes an image on a front face of a device under test by the reflected light of light from the 2nd light source A means to create a signal which may display a mark for comparing with a condensing location of light from the 1st light source on an image obtained in this image pick-up section in piles

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Industrial Application] This invention relates to the displacement gage which can

display a surface inclination while being able to measure the variation rate of the front face of a device under test.

[0002]

[Description of the Prior Art] For example, the focus inspection appearance type non-contact displacement gage is used as equipment which measures the variation rate of the front face of device under tests, such as a metal and resin. Drawing 10 is the mimetic diagram of a displacement gage for an applicant for this patent to enforce the displacement measurement method which is carrying out patent application by Japanese Patent Application No. No. 257255 [five to]. It is projected on the outgoing radiation light from the light source C in the location which measures the variation rate of the front face of a device under test B through a beam splitter D, a collimate lens L, and objective lens A. It is made to drive a collimate lens L that it should vibrate in the direction of an optical axis by the lens driving means which is not illustrated. The amplitude of objective lens A is detected by the lens location detection means G. Incidence of the light which the reflected light of a device under test B reflected by the beam splitter D is carried out to a photo detector E through optical converging section H which consists of a pinhole.

[0003] Next, actuation of this non-contact displacement gage is explained. The outgoing-radiation light from the light source C projects on a device under test B through a beam splitter D, a collimate lens L, and objective lens A, and it changes like the curve Q of drawing 11 which the detection output of the lens location detection means G carries out change according to the location of objective lens A, and the location of objective lens A makes a horizontal axis time amount, and makes an axis of ordinate the location of an objective lens if a collimate lens L and objective lens A vibrate in the direction of an optical axis shown by the arrow mark with the predetermined amplitude. Moreover, it reflects by the beam splitter D and incidence of the reflected light from a device under test B is carried out to a photo detector E through optical converging section H. And it becomes max, whenever the focusing point of the light projected into 1 period of an oscillation of objective lens A at the device under test B arises twice in a device under test B and a focusing point arises, the light income, i.e., the light-receiving output, of a photo detector E. That is, when objective lens A and a device under test B become predetermined distance, a focusing point arises in a device under test B.

[0004] Here, it is the variation rate of the front face of a device under test B. (height) High, Inside, When light is projected on the height location low [the] noting that it is a low three-stage Before objective lens A carries out a closest approach to a device under test B A focusing point arises in a device under test B at next each event, the light-receiving output of a photo detector E serves as max, and it is drawing 12 (a). The focus inspection appearance signals Z and Z occur so that it may be shown., Moreover, a focusing point arises in a device under test B at the medium event with the event of maximum-deserting with the event of objective lens A carrying out a closest approach to a device under test B, when light is projected on the inner height location, the light-receiving output of a photo detector E serves as max, and it is drawing 12 (b). The focus inspection appearance signals Z and Z occur so that it may be shown. Furthermore, it is when light is projected on the high

height location, before maximum-deserting objective lens A at a device under test B, At the next event, a focusing point arises in a device under test B, the light-receiving output of a photo detector E serves as max, and it is drawing 12 (c). The focus inspection appearance signals Z and Z occur so that it may be shown.

[0005] Thus, it will correspond to the distance from the location of objective lens A at the time of the focus inspection appearance signals Z and Z occurring, and the criteria location of optical system to a device under test B, and if a device under test B is moved in the direction which intersects perpendicularly with an optical axis, the variation rate of the front face of a device under test B can be measured.

[0006]

[Problem(s) to be Solved by the Invention] Thus, although the variation rate of the front face of a device under test can be measured in the displacement gage mentioned above, there is a problem that the inclination of the front face of the device under test which has measured the variation rate is not discriminable. This invention aims at offering the displacement gage which can identify the inclination of point of measurement while it can measure the variation rate of the front face of a device under test in view of this problem.

[0007]

[Means for Solving the Problem] A displacement gage concerning the 1st invention projects light in which the 1st light source carried out outgoing radiation on a device under test through an objective lens, and receives the reflected light from a device under test which passed along this objective lens by light sensing portion. The 2nd light source which irradiates light of wavelength of light in which is the displacement gage which measures a variation rate of a front face of a device under test, and said 1st light source carries out outgoing radiation, and different wavelength to said device under test, The image pick-up section which is projected on light from the 1st light source reflected by device under test, and the 2nd light source through said objective lens, and picturizes an image on a front face of a device under test by the reflected light of light from the 2nd light source, It is characterized by having a means to create a signal which may display a mark for comparing with a condensing location of light from the 1st light source on an image obtained in this image pick-up section in piles.

[0008] A displacement gage concerning the 2nd invention projects light in which the 1st light source carried out outgoing radiation on a device under test through an objective lens which vibrates with predetermined amplitude in the direction of an optical axis of this light, and receives the reflected light from a device under test which passed along this objective lens by light sensing portion. The 2nd light source which irradiates light of wavelength of light in which is the displacement gage which measures a variation rate of a front face of a device under test based on a location of an objective lens at the light-receiving output maximum event of this light sensing portion, and the 1st light source carries out outgoing radiation, and different wavelength to a device under test, The image pick-up section which is projected on light from the 1st light source reflected by device under test, and the 2nd light source through said objective lens, and picturizes an image on a front face of a device under test by the reflected light of light from the 2nd light source, It is characterized

by having a means to create a signal which may display a mark for comparing with a condensing location of light from the 1st light source on an image obtained in this image pick-up section in piles.

[0009]

[Function] In the 1st invention, the outgoing radiation light from the 1st light source is projected on a device under test through an objective lens, and the focusing point of the outgoing radiation light arises in a device under test. A light sensing portion receives the reflected light from the device under test which passed along the objective lens, and the variation rate of the front face of a device under test is measured.

[0010] If it is projected on the light which the outgoing radiation light from the 2nd light source reflected by the device under test through an objective lens to the image pick-up section, the surface image of a device under test will carry out image formation to the image pick-up section. If it is projected on the light which the outgoing radiation light from the 1st light source reflected by the device under test through an objective lens to the image pick-up section, the light figure to which chromatic aberration arose with the objective lens, and the outline faded in the image pick-up section will arise. Moreover, when projected on the incident light from the 1st light source on the front face of the device under test which intersects perpendicularly with the optical axis, the optical axis of the reflected light passes along the center of an objective lens, when projected on the front face of the device under test of an optical axis and not intersecting perpendicularly, it is projected on the reflected light by the image pick-up section through the location which separated from the center of an objective lens, and the locations of the light figure produced in the image pick-up section differ. When light is projected on the field of an optical axis and not intersecting perpendicularly after displaying the mark in comparison with a light figure on the image which projected light on the field which intersects perpendicularly with an optical axis, and was obtained in the image pick-up section in piles, a light figure separates to the mark. The front face of a device under test is a rectangular cross to the optical axis of the 1st light source by the location of the light figure and mark which could measure the variation rate of the front face of a device under test, and were produced in the image pick-up section by this, It is discriminable whether it intersects perpendicularly.

[0011] In the 2nd invention, the outgoing radiation light from the 1st light source is projected on a device under test through an objective lens, and a light sensing portion receives the reflected light. When the objective lens was vibrated in the direction of an optical axis, the distance of an objective lens and a device under test changes and predetermined distance is reached, the focusing point of the projected light arises in a device under test, and the light-receiving output of a light sensing portion becomes max to it. The location of the objective lens at that time corresponds to the distance from the criteria location of optical system to a device under test, and can measure the variation rate of the front face of a device under test.

[0012] If it is projected on the light which the outgoing radiation light from the 2nd light source reflected by the device under test through an objective lens to the image pick-up section, the surface image of a device under test will carry out image formation to the image pick-up section. If it is projected on the light which the

outgoing radiation light from the 1st light source reflected by the device under test through an objective lens to the image pick-up section, the light figure to which chromatic aberration arose with the objective lens, and the outline faded in the image pick-up section will arise. Moreover, when projected on the incident light from the 1st light source on the front face of the device under test which intersects perpendicularly with the optical axis, the reflected light passes along the center of an objective lens, when projected on the front face of the device under test of an optical axis and not intersecting perpendicularly, it is projected on the reflected light by the image pick-up section through the location which separated from the center of an objective lens, and the locations of the light figure produced in the image pick-up section differ. When light is projected on the field of an optical axis and not intersecting perpendicularly after displaying the mark in comparison with a light figure on the image which projected light on the field which intersects perpendicularly with an optical axis, and was obtained in the image pick-up section in piles, a light figure separates to the mark. The front face of a device under test is a rectangular cross to the optical axis of the 1st light source by the location of the light figure and mark which could measure the variation rate of the front face of a device under test, and were produced in the image pick-up section by this, It is discriminable whether it intersects perpendicularly.

[0013]

[Example] This invention is explained in full detail below with the drawing in which the example is shown. Drawing 1 is the typical block diagram of the displacement gage concerning this invention. For example, it is projected in the location where the outgoing radiation light of the 1st light source slack light source 1 which consists of semiconductor laser measures a beam splitter 2, a half mirror 3, a collimate lens 4, and an objective lens 5, and a connoisseur measures the variation rate of the front face of a device under test 6 one by one. The collimate lens 4 is attached in the head side of 1 side length **** of the U character-like tuning fork 7, and the objective lens 5 is attached in the head side of side length **** else. A tuning fork 7 is approached and the exiting coil 8 for tuning fork actuation is arranged in the side of a tuning fork 7.

[0014] The lens location sensing coil 9 which detects the location of the oscillation 4 of a tuning fork 7, i.e., a collimate lens, and an objective lens 5 is arranged in the location which deserted slightly the head of 1 side length **** of a tuning fork 7. Near the objective lens 5, the light source 13 for the 2nd light source slack image pick-up which the metaphor which irradiates a device under test 6 becomes from light emitting diode is arranged. The wavelength of the light in which the light source 13 for an image pick-up carries out outgoing radiation is selected from the wavelength of the light in which the light source 1 carries out outgoing radiation by long wave length.

[0015] It is projected on the light which reflected the reflected light which the light from the light source 1 and the light source 13 for an image pick-up reflected by the device under test 6 by the half mirror 3 through the objective lens 5 and the collimate lens 4, and was reflected by the half mirror 3 to the image pick-up section slack image photo detector 10 which consists of CCD (Charge Coupled Device). A half

mirror 3 is selected by the large reflection factor to the reflected light of the light from the light source 13 for an image pick-up, and is selected by the small reflection factor to the reflected light of the light from the light source 1.

[0016] The image photo detector 10 locates an image light-receiving side in the focal location of the reflected light of the light of the light source 13 for an image pick-up reflected by the device under test 6, and is positioned. Moreover, it is projected on the reflected light of the light of the light source 1 from the device under test 6 which passed along the half mirror 3 to a photo detector 12 through the optical converging section 11 which reflects by the beam splitter 2, for example, consists of a pinhole. In addition, LC shows the optical axis of the outgoing radiation light from the light source 1. Detecting-signal S9 of the lens location sensing coil 9 It is inputted into the location detector 20 and amplifier 15. The output signal S20 of the location detector 20 is inputted into the actuation circuit 21 and the zero cross timing detector 22. The output signal S22 of the zero cross timing detector 22 is Timer TMR. It is inputted into the built-in control circuit 23.

[0017] The output signal S21 of the actuation circuit 21 is inputted into an exiting coil 8. The light-receiving output slack output signal S12 of a photo detector 12 is inputted into the peak timing detector 24 and amplifier 16. The output signal S24 of the peak timing detector 24 is inputted into a control circuit 23. The control signal S23 outputted from a control circuit 23 is inputted into the light source actuation circuit 25, and the output signal S25 is inputted into the light source 13 for an image pick-up. The picture signal S10 which the image photo detector 10 outputs is CRT. It is inputted into the used display unit 26. Cursor display-control section 26a which displays the cursor which is the mark which directs the predetermined location of a screen on this display unit 26 It builds. The output signal Y of amplifier 15 and the output signal X of amplifier 16 are inputted into operation part 17. The displacement signal S38 which operation part 17 outputs is inputted into the distance transform section 18.

[0018] Drawing 2 is the block diagram showing the configuration of operation part 17. Amplifier 16 (refer to drawing 1) inputted into operation part 17 An output signal X is inputted into a differentiator 30 and plus input terminal + of the 1st comparator 31. In negative input terminal - of a comparator 31, it is reference voltage Vref. It is inputted. The output signal S30 of a differentiator 30 is inputted into negative input terminal - of the 2nd comparator 32. Plus input terminal + of a comparator 32 is grounded. Comparators 31 and 32 An output signal S31 and S32 are AND. It is inputted into the 1 side input terminal of a circuit 33, and the side input terminal else at each **, and the output signal S33 is inputted into the single shot pulse generating circuit 34. The single shot pulse S34 which the single shot pulse generating circuit 34 outputs is given as ON and an off control signal to Switch SW.

[0019] amplifier 15 (refer to drawing 1) from -- an output signal Y is inputted into amplifier 36 through amplifier 35 and Switch SW. The input side of amplifier 36 is grounded through the capacitor 37. Amplifier 36 and a capacitor 37 constitute the sample hold circuit 38, and the displacement signal S38 is outputted from amplifier 36.

[0020] Next, actuation of the displacement gage constituted in this way is explained.

If the high frequency current is supplied to an exiting coil 8 from the actuation circuit 21, a magnetic field will occur with an exiting coil 8, a tuning fork 7 will vibrate with the predetermined amplitude by this magnetic field, and a collimate lens 4 and an objective lens 5 will vibrate in the direction of an optical axis of the light from the light source 1 which passes along them. The lens location sensing coil 9 is the location of a collimate lens 4 and an objective lens 5. (amplitude) It detects and is the detecting-signal S9. It amplifies with amplifier 15 and the output signal Y outputted from amplifier 15 is inputted into operation part 17.

[0021] Moreover, if outgoing radiation of the light is carried out from the light source 1, it will be projected on the light on the front face of a device under test 6 through a beam splitter 2, a half mirror 3, a collimate lens 4, and an objective lens 5. And it reflects by the beam splitter 2 through an objective lens 5, a collimate lens 4, and a half mirror 3, and incidence of the reflected light reflected by the device under test 6 is carried out to a photo detector 12 through the optical converging section 11. Thereby, only the light of the focusing point produced in the device under test 6 carries out incidence to a photo detector 12.

[0022] By the way, when the collimate lens 4 and the objective lens 5 are vibrating in the direction of an optical axis, the distance of an objective lens 5 and a device under test 6 changes and predetermined distance is reached If the focusing point of the light which carried out outgoing radiation arises from the light source 1 in a device under test 6, the light-receiving output of a photo detector 12 will serve as max in an instant, the output signal S12 according to this light-receiving output is inputted into amplifier 16, and it is drawing 3 (a) from amplifier 16. The shown output signal X is outputted and it inputs into operation part 17.

[0023] Thus, when output signals X and Y are inputted into operation part 17, it differentiates with a differentiator 30 and an output signal X is drawing 3 (b) from a differentiator 30. The output signal S30 of a differential wave which carried out the shape of reverse of S characters as shown is outputted. And the maximum of an output signal X is T0 at the zero cross event of an output signal S30. It will be detected and the event of the focusing point of the light projected on the device under test 6 arising will be detected to accuracy. This output signal S30 is inputted into a comparator 32, a comparator 32 carries out the size comparison of an output signal S30 and the touch-down potential, and it is T0 from a comparator 32 at the zero cross event of an output signal S30. Drawing 3 of the pulse width corresponding to [start and] the period of the negative half period of an output signal S30 (d) The output signal S32 of the shown pulse is outputted.

[0024] On the other hand, a comparator 31 is an output signal X and reference voltage Vref. A size comparison is carried out and an output signal X is reference voltage Vref from a comparator 31. Drawing 3 of the pulse width corresponding to the period which is above (c) The shown output signal S31 is outputted. It is AND if these output signals S31 and the logic of S32 are materialized. A circuit 33 to drawing 3 (e) The output signal S33 of the shown pulse is outputted, and it inputs into the single shot pulse generating circuit 34. Thereby, the single shot pulse generating circuit 34 is drawing 3 (f) which starts synchronizing with the standup of an output signal S33. The shown single shot pulse S34 is outputted. And Switch SW is made to turn on by

this single shot pulse S34.

[0025] If it does so, the output signal Y of the amplifier 35 which amplified the output signal Y is inputted into a sample hold circuit 38 through Switch SW, and a sample hold circuit 38 will sample and hold the signal level of an output signal Y, will amplify it with amplifier 36, and will output the displacement signal S38. The level of the output signal Y at the zero cross event of an output signal S30 by this, i.e., the location of an objective lens 5, (amplitude) It will sample. Thus, the location of the sampled objective lens 5 corresponds to the distance from the criteria location of optical system to a device under test 6. And the sampled displacement signal S38 is inputted into the distance transform section 18, the displacement signal S38 is changed into the distance according to the displacement signal S38, and the variation rate of the front face of a device under test 6 is measured.

[0026] Drawing 4 is the timing chart of an output signal Y, the single shot pulse S34, and the displacement signal S38. As mentioned above, it is the location of an objective lens 5. (amplitude) As it corresponded and was shown in drawing 4 (a), while the output signal Y was changing, when the focusing point arose in the device under test 6, it is drawing 4 (b). Generating of the shown single shot pulse S34 samples the level of the output signal Y at the event. And when a device under test 6 is moved in the direction which intersects perpendicularly with an optical axis LC, it responds to the variation rate of the front face of a device under test 6, and the displacement signal S38 is drawing 4 (a). It changes stair-like so that it may be shown, and the level of the displacement signal S38 and the variation rate of the front face of a device under test 6 correspond. Therefore, if the level of an output signal Y is sampled, according to the level of an output signal Y, the variation rate of a device under test 6 can be measured to high degree of accuracy.

[0027] On the other hand, it is output signal S9 of the lens location sensing coil 9. That is inputted into the location detector 20 and the output signal S20 is drawing 5 (a). According to the location of an objective lens 5, level changes so that it may be shown. Moreover, the level of the output signal S12 of a photo detector 12 is drawing 5 (b), when the focusing point of the light projected on the device under test 6 arose. It becomes max in an instant so that it may be shown. And the output signal S24 of the peak timing detector 24 is drawing 5 (c). The pulse P0 which starts at the maximum event of an output signal S12, and falls with predetermined pulse width so that it may be shown, and P1 It becomes and is inputted into a control circuit 23.

[0028] Furthermore, the output signal S20 of the location detector 20 is inputted into the zero cross timing detector 22, the zero cross event of an output signal S20 is detected, and the output signal S22 is drawing 5 (d). It becomes the pulse which starts at the zero cross event of an output signal S20, and falls at the following zero cross event so that it may be shown. Thereby, a control circuit 23 is the timer TMR built in the control circuit 23 from the standup event of an output signal S22. It drives and is the pulse P0 of the standup event of an output signal S22 to the output signal S24. Time amount ta of a standup event And pulse P1 of an output signal S24 Time amount tb of a standup event It clocks, respectively. Then, a two periods [of an output signal S20], i.e., 3rd zero cross, event to the time amount ta and

tb When clocked, it is a control circuit 23 to drawing 5 (e). The pulse P2 of the shown control signal S23, and P3 It outputs and inputs into the light source actuation circuit 25. When it does so, it is a pulse P2 and P3. It responds, actuation current is supplied to the light source 13 for an image pick-up, and the light source 13 for an image pick-up is the pulse P2 of an output signal S23, and P3. Light is synchronously emitted in instant.

[0029] And this light is irradiated by the front face of a device under test 6 in instant, and that reflected light carries out incidence to a half mirror 3 through an objective lens 5 and a collimate lens 4, it is projected on the light reflected here to the image photo detector 10, and the surface image of a device under test 6 carries out image formation to the image photo detector 10. And the picture signal which the image photo detector 10 outputs is inputted into a display unit 26, and the surface image of the device under test 6 which carried out image formation to the image photo detector 10 is displayed on the screen of a display unit 26. the pulse P2 of a control signal S23 and P3 since it synchronizes with the output signal S12 of the photo detector 12 used as max when a focusing point arises in a device under test 6 and the light source 13 for an image pick-up emits light when a focusing point arises in a device under test 6, resemble a device under test 6 light source 1 -- the surface image of the device under test 6 which the focusing point of light has produced is displayed on the screen of a display unit 26. [and]

[0030] By the way, since the wavelength of the light in which the light source 1 carries out outgoing radiation differs from the wavelength of the light in which the light source 13 for an image pick-up carries out outgoing radiation, chromatic aberration will arise with an objective lens 5, the incident light from the light source 1 and the light source 13 for an image pick-up will reflect by the device under test 6, and the focal locations of the light which passed along the objective lens 5 will differ. The front face of a device under test 6 where it is now projected on the outgoing radiation light from the light source 1 is drawing 6 (a). It is the optical axis LC of the outgoing radiation light from the light source 1 (refer to drawing 1) so that it may be shown. The reflected light in which the outgoing radiation light from the light source 1 and the light source 13 for an image pick-up reflected by the device under test 6 in the case of the flat side floor line which lies at right angles passes along the center of an objective lens 5, and it is projected on it by the image photo detector 10. And the reflected light which the outgoing radiation light from the light source 1 reflected by the device under test 6 (it expresses as a continuous line) The focusing point of the reflected light arises just before the image photo detector 10.

[0031] The reflected light which the outgoing radiation light from the light source 13 for an image pick-up reflected by the device under test 6 on the other hand (it expresses as a dashed line) A focusing point arises in the image photo detector 10. Therefore, in the image light-receiving side of the image photo detector 10, the circular light figure R to which the focus with the comparatively large path size by the reflected light of the outgoing radiation light from the light source 1 faded arises. On the other hand, since the surface image of a device under test 6 carries out image formation to the image photo detector 10, it is thought that the fictitious

pinpoint light figure r with the very small path size by the reflected light of the outgoing radiation light from the light source 13 for an image pick-up arises. And those light figures will be located in the shape of the said heart.

[0032] On the other hand, the front face of a device under test 6 is drawing 6 (b). It is the optical axis LC of the outgoing radiation light from the light source 1 (refer to drawing 1) so that it may be shown. When it is the inclined plane RL which received and inclined on right-hand side, the reflected light which the outgoing radiation light from the light source 1 and the light source 13 for an image pick-up reflected in the inclined plane RL of a device under test 6 passes along the near location to which the inclined plane RL which separated from the center of an objective lens 5 leans, and it is projected on it by the image photo detector 10. And the reflected light which the outgoing radiation light from the light source 1 reflected by the device under test 6 (it expresses as a continuous line) The focusing point of the reflected light arises just before the image photo detector 10. The reflected light which the outgoing radiation light from the light source 13 for an image pick-up reflected by the device under test 6 on the other hand (it expresses as a dashed line) A focusing point arises in the image photo detector 10.

[0033] Therefore, in the image light-receiving side of the image photo detector 10, the circular light figure R to which the focus with the comparatively large path size by the reflected light of the outgoing radiation light from the light source 1 faded arises. On the other hand, since the surface image of a device under test 6 carries out image formation to the image photo detector 10, it is thought that the fictitious pinpoint light figure r with the very small path size by the reflected light of the outgoing radiation light from the light source 13 for an image pick-up arises. And when the reflected light from a device under test 6 separated from the center of an objective lens 5 to right-hand side, the circular light figure R will be produced on the left-hand side of the pinpoint light figure r, and the locations of those light figures will differ.

[0034] Furthermore, the front face of a device under test 6 is drawing 6 (c). It is the optical axis LC of the outgoing radiation light from the light source 1 (refer to drawing 1) so that it may be shown. When it is the inclined plane LL which received and inclined on left-hand side, it is projected on the reflected light which the outgoing radiation light of the light source 1 and the light source 13 for an image pick-up reflected in the inclined plane LL of a device under test 6 by the image photo detector 10 through the near location to which the inclined plane LL which separated from the center of an objective lens 5 leans. And the reflected light which the outgoing radiation light from the light source 1 reflected by the device under test 6 (it expresses as a continuous line) The focusing point of the reflected light arises just before the image photo detector 10.

[0035] The reflected light which the outgoing radiation light from the light source 13 for an image pick-up reflected by the device under test 6 on the other hand (it expresses as a dashed line) A focusing point arises in the image photo detector 10. Therefore, in the image light-receiving side of the image photo detector 10, the circular light figure R to which the focus with the comparatively large path size by the reflected light of the outgoing radiation light from the light source 1 faded

arises. On the other hand, since the surface image of a device under test 6 carries out image formation to the image photo detector 10, it is thought that the fictitious pinpoint light figure r with the very small path size by the outgoing radiation light from the light source 13 for an image pick-up arises. And when the reflected light from a device under test 6 separated from the center of an objective lens 5 to left-hand side, the circular light figure R will be produced on the right-hand side of the pinpoint light figure r, and the locations of those light figures will differ.

[0036] Thus, based on the location of the circular light figure R, it is discriminable whether it is an inclined plane non-intersecting perpendicularly to whether it is the flat side where the field which has projected the outgoing radiation light from the light source 1 on the device under test 6 lies at right angles to the optical axis LC of the outgoing radiation light from the light source 1, and an optical axis LC.

[0037] And if the picture signal which this image photo detector 10 outputs is inputted into a display unit 26, the image formation and the circular light figure R which were produced in the image photo detector 10 can be displayed on that screen. Next, drawing 7 and drawing 8 explain how to identify the inclination of the front face of a device under test with the image which did in this way and was displayed on the screen.

[0038] First, the outgoing radiation light from the light source 1 is projected on the flat datum level which intersected perpendicularly to the optical axis LC of the outgoing radiation light from the light source 1. When it does so, it is drawing 6 (a). The circular light figure R to which the focus by the reflected light of the outgoing radiation light from the light source 1 faded to the image photo detector 10 arises so that it may be shown, and the circular light figure R is displayed on the screen of a display unit 26. Then, cursor display-control section 26a in a display unit 26 It is Cursor CSR to a screen. It is made to display and is drawing 8 (b). It is the cursor CSR so that it may be shown. It moves and fixes to homotopic so that it may lap with the circular light figure R currently displayed.

[0039] Now, when it is projected on the outgoing radiation light from the light source 1 in the inclined plane RL of the front face of a device under test 6 as shown in drawing 7 , and the light source 13 for an image pick-up emits light, it is drawing 6 (b). The circular light figure R to which the focus by the reflected light of the outgoing radiation light from the light source 1 faded to the image photo detector 10 as it was shown arises, and the surface image of the device under test 6 by the reflected light of the outgoing radiation light from the light source 13 for an image pick-up carries out image formation. And the circular light figure R is drawing 6 (a). The light figure location which produced in the left compared with the case and was produced in the image photo detector 10 is reversed, and it is drawing 8 (c) in the screen of a display unit 26. It is Cursor CSR in the surface image of a device under test 6 so that it may be shown. The circular light figure R is displayed on right-hand side. Thereby, it is Cursor CSR. The difference in a location with the circular light figure R is seen, and it can identify that the field which has measured the surface variation rate is the inclined plane RL of right going down.

[0040] Next, when it is projected on the outgoing radiation light of the light source

1 in the flat side floor line of the front face of a device under test 6 shown in drawing 7 and the light source 13 for an image pick-up emits light, it is drawing 6 (a). The circular light figure R to which the focus by the outgoing radiation light from the light source 1 faded to the image photo detector 10 as it was shown arises, and the surface image of the device under test 6 by the reflected light of the outgoing radiation light from the light source 13 for an image pick-up carries out image formation. And the circular light figure R is drawing 6 (b). Compared with a case, it moves to rightist inclinations, the light figure location produced in the image photo detector 10 is reversed, and it is drawing 8 (b) in the screen of a display unit 26. While the surface image of a device under test 6 is displayed so that it may be shown, the circular light figure R is Cursor CSR. It is displayed on homotopic. It is discriminable that it is the flat side floor line where the optical axis LC of the outgoing radiation light from the light source 1 and the field which has measured the surface variation rate by this crossed at right angles like datum level.

[0041] Next, while being projected on the outgoing radiation light from the light source 1 in the inclined plane LL of the front face of a device under test 6 shown in drawing 7 , when the light source 13 for an image pick-up emits light, it is drawing 6 (c). The circular light figure R to which the focus by the reflected light of the outgoing radiation light from the light source 1 faded to the image photo detector 10 as it was shown arises, and the surface image of the device under test 6 by the reflected light of the outgoing radiation light from the light source 13 for an image pick-up carries out image formation. And the circular light figure R is drawing 6 (a). The light figure location which produced in rightist inclinations compared with the case, and was produced in the image photo detector 10 is reversed, and it is drawing 8 (a) in the screen of a display unit 26. It is Cursor CSR, while the surface image of a device under test 6 is displayed so that it may be shown. The circular light figure R is displayed on left-hand side. Thereby, it is Cursor CSR. It is discriminable that the field which looked at the difference in a location with the circular light figure R, and has measured the surface variation rate is the inclined plane LL of left going down.

[0042] Moreover, the degree of the inclination of the front face of a device under test 6 is the circular light figure R and Cursor CSR which were displayed on the screen. It corresponds to the distance of a between and they are the circular light figure R and Cursor CSR. The degree of the inclination of the front face which has measured the variation rate is discriminable from distance.

[0043] Drawing 9 is property drawing having shown the reflection factor property of a half mirror 3, makes a horizontal axis wavelength and makes the axis of ordinate the reflection factor. When the reflection factor in the half mirror 3 of the reflected light which the outgoing radiation light from the light source 1 reflected by the device under test 6 is large It will be projected on the reflected light which the outgoing radiation light from the light source 1 reflected by the device under test 6 so much to the image photo detector 10. The light income of the image photo detector 10 becomes excessive, the screen of a display unit 26 will be too bright, and the display of the circular light figure R cannot be performed, but it becomes impossible to identify the inclination of the front face of a device under test 6.

[0044] Then, the reflection factor has selected the reflection factor which the reflected light of the outgoing radiation light from the light source 13 for an image pick-up reflects by the half mirror 3 as shown in drawing 9 like the reflection factor curve CC which falls rapidly as it is made to become max on the wavelength of the light L13 of the light source 13 for an image pick-up and wavelength becomes for a long time and short from it. And light L1 from the light source 1 It is made to reflect with the very small reflection factor of a half mirror 3. Thus, the wavelength of the light by which outgoing radiation is carried out is selected from the two light sources so that the reflected light of the outgoing radiation light from the light source 1 may decrease the amount on which it is projected to the image photo detector 10, and he is trying to display the circular light figure R on a screen proper. At this example, it is CCD to an image photo detector. It is CCD although used. The same effect is acquired even if it is the image photo detector of an except.

[0045]

[Effect of the Invention] It is a rectangular cross to the optical axis of the light source with which the field which has measured the variation rate measures the variation rate of the front face of a device under test while being able to measure the variation rate of the front face of a device under test according to this invention, as explained in full detail above, It is discriminable whether it intersects perpendicularly. Moreover, the outstanding effect which can offer the displacement gage which can look for easily the top-most vertices of the front face of a device under test by the discernment is done so.